Deployment of an All-in-One Millimetre-wave Anechoic Chamber

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***Abstract*—This paper describes the new anechoic chamber available at The University of Kent, UK. This facility includes a spherical near/far field, planar near field, cylindrical near field and a compact range. The facility allows measurement from 600 MHz up to 110 MHz. The spherical, planar and cylindrical ranges covers up to 40 GHz and the compact range is available from 50 GHz up to 110 MHz. Immediate plans are to use the new facility to measure body-centric antennas and sensing nodes together with near field sampling of finite sized Frequency Selective Surfaces.**

Index Terms*—*antenna measurements, near-far processing, muillimetric antenna measurements.

I. Introduction

Over the past 45 years, the antennas group at the University of Kent, UK, has designed and measured antenna structures over a wider range of applications and bands, for instance Radio Astronomy [1] to Aerospace dichroic systems at 160GHz, [2]. More recently work has been carried out on ceramic LTCC RF system on chip for application at 60GHz, [3] and novel printed UHF structures for bodycentric applications and RFID, [4 & 5]. In order to address the wide range of design activities associated with research ranging from UHF through to mm-metric antenna design, a new single anechoic chamber offering multi-measurement functionality has been created for the Kent group. RF measurement is provided by Rohde&Schwarz with the positioning and control developed by ASYSOL, Madrid. The new facility is a multisystem anechoic chamber that goes from 600 MHz up to 110 GHz in a small chamber. Lower frequencies (below 40 GHz) are covered with spherical, planar and cylindrical systems and near field transformation tools are provided. Moreover, the spherical range also provides far field measurement. Finally, at frequencies from 50 GHz to 110 GHz a compact range provides far field measurement with mixer power controlled to maximize the dynamic margin at millimetric frequencies.

II. Facilities Description

A. Spherical Near-Far Field

When moving the cover slider, a spherical range can be deployed between the AUT tower (roll on elevation over azimuth positioned) and the probe tower (Y positioned of the planar scanner). The maximum range is about 3600 mm .

B. Planar Near Field

When placing the AUT on the roll on elevation over the azimuth positioner, and scanning with the X-Y positioners, a planar system is available. The X scan travel is about 1800 mm and the Y scan travel is about 2300 mm.

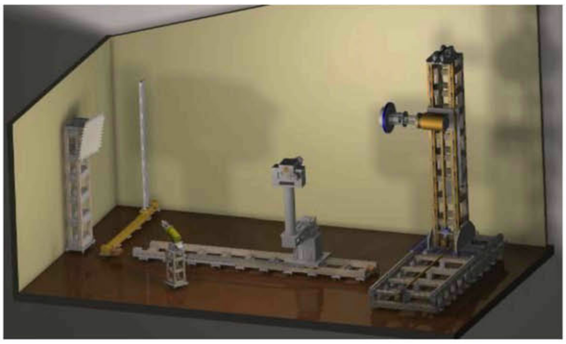

Figure 1. Sketch of Kent'sinstallation

C. Cylindrical Near Field

A cylindrical system can be defined between the AUT tower (the roll on elevation over the azimuth positioner) using the just its azimuth positioner and the probe tower at the Y axis of the scanner. A cylinder of height of 2300 mm can be scanned.

D. Compact Range

Once the cover is removed, a serrated offset reflector is available. The probe is placed on the small roll tower of figure 1 and the AUT is placed on the roll on elevation over azimuth positioner.

III. Facility Test

A. Measurement of the flatness of the X-Y scaner.

Planar scanner validation involved its flatness verification after the installation. Flatness measurements are a series of straightness measurements made along a pattern of lines combined to evaluate the flatness of a surface in three dimensions using an interferometric laser, and an angular optics and flatness kits.

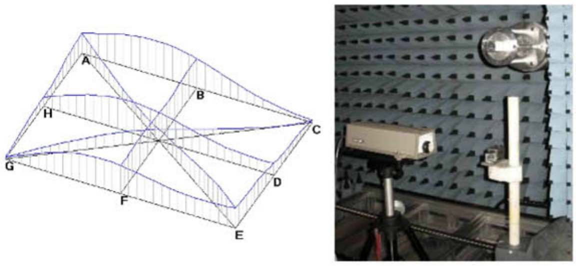

Figure 2. Moddy's flatness test performed using a laser tracker measurement

Measurement area covered all the horizontal range (±700 cm) while the vertical range is only covered in the central zone (±600 cm). The result of the Moody's processing (figure 2) provided a standard deviation of 44.883μm and a peak to peak error of 171.785μm.

B. *CATR On-Site Quality Test.*

The measurement of the quality of the quiet zone of the Compact Test Range is one of the necessary tests to be performed after the installation.

The measurements consisted on the horizontal scanning in amplitude and phase in front of the CATR reflector. Measurement area covered the central area of the CATR range (±20 cm) providing the amplitude and phase ripple in order to demonstrate the quality. The ±20 cm covered widely the specified quiet zone diameter of 30 cm. Measurements were performed using the own chamber equipment (ZVA), according to figure 3. It shows the slider placed on the roll over azimuth positioner scanning the area in front of the Compact range reflector, and the feeder placed on focal point of the CATR reflector.

The slider necessary for the millimetric quality test needs to have high straightness to avoid errors in the phase measurement. ASYSOL's slider has an accuracy of ±0.02 mm that produces an error in the phase measurement of ±2.4° at 100 GHz.

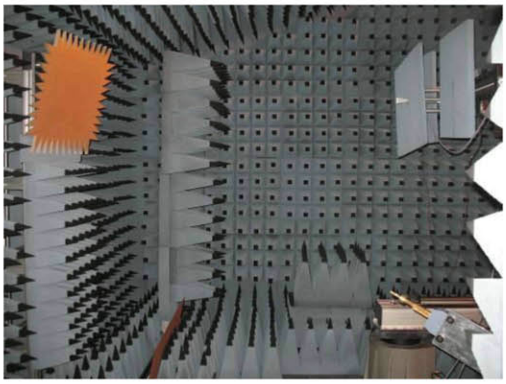

Figure 3. Set-up CATR Quality Test

Two different sets of measurements have been performed at 27 GHz, 40 GHz, 75 GHz and 100GHz.. Copolar measurements at both polarizations (plots H-H and V-V) provides ripple while crosspolar measurement provides isolation H-V. Copolar measurements at 27 GHz showed an amplitude ripple better than ± 0.4 dB and a phase ripple better than ±4°, that are lower than the specifications. Crosspolar level (difference between copolar scan and crosspolar scan) fulfills widely the specification of - Measurements at 100 GHz showed a copolar amplitude ripple is better than ± 0.4 dB along the scanning and a phase ripple (not taking into account the linear slope) better than ±4° is found. Both ripples are lower that specification requirements. Finally, the crosspolar level is lower than -30 dB (typical specification).30 dB.

C. *Golden Antenna Measurements*

The golden antenna for lower frequencies is a displaced Gregorian reflector of 40 cm of diameter, as it can be seen in figure 4. The reference measurements have been measured at LEHA, anechoic chamber of the ETSIT-UPM.

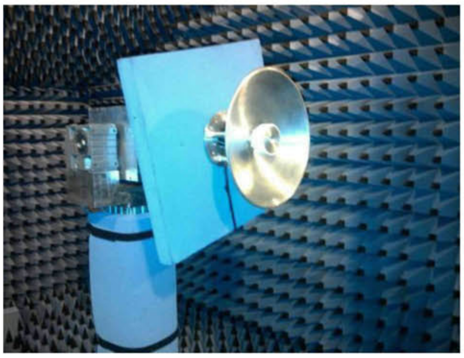

Figure 4. Gold Antenna at 12.5 GHz

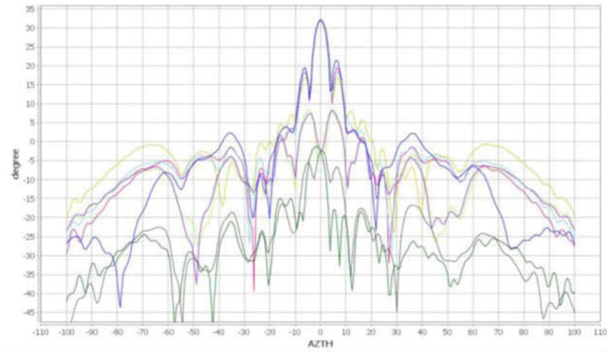

Figure 5. Patterns of gold antenna measured at 12.5 GHz. FFT interpolated x4 (φ=0° CP blue, φ=45° CP cyan, φ=90° CP yellow, φ=135° CP pink, φ=0° XP olive green, φ=45° XP green, φ=90° CP brown and φ=135° XP violet)

The selected golden antenna at higher frequencies has been the SGH corresponding to the band from 50 GHz to 110 GHz. The measurements of the principal planes of the SGH have been performed at 50 GHz, 75 GHz, 80 GHz and 110 GHz. The results at 80 GHz can be found in figure 6.

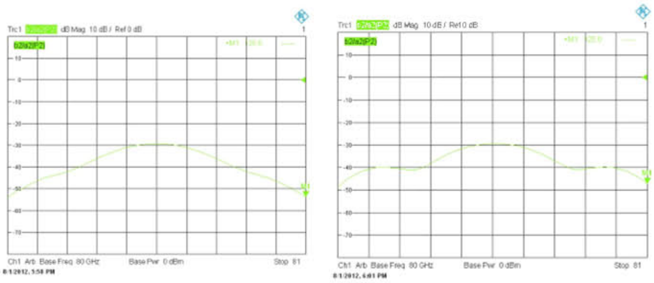

Figure 6. Principal planes of SGH (75-110 GHz) measured at 80 GHz: φ=0º CP (left) φ=90º CP (right)

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